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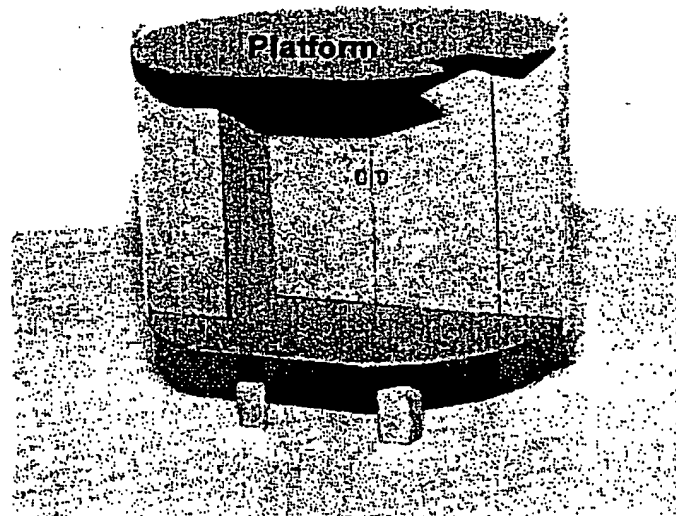
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- (54) Benævnelse:
 Transformatormodul til placering i
 vindmølle

- (57) Sammen drag:
 Denne frembringelse angår et transformatormodul til placering i vindmøller, der gør det muligt at montere en transformator og øvrige højspændingsinstallationer inde i vindmøllens tårn på en rationel og billig måde. Frembringelsen er ny ved, at transformatorstationen er tilpasset vindmøllens form, at den udgør en selvstændig og komplet enhed, at den er forsynet med kraftige løftebeslag, at den øverst er forsynet med en stabil og kraftig platform samt at den, i de tilfælde hvor den opstilles direkte på vindmøllens støbte fundament, er forsynet med ben, der gør monteringsarbejde under modulet mulig. Modulet kan enten opstilles direkte på vindmøllens fundament eller monteres oppe i vindmøllens tårn. Transformatormodulet er øverst forsynet med en platform hvorpå der kan opstilles styreskabe til vindmøllen, og er udformet således at montage og service af vindmøllen og transformatormodulet er mulig. Transformatormodulet overflødiggør opstilling af udvendig transformatorstation. Modulet er velegnet ved opstilling af vindmøller alle steder, bl.a. på havet.



Beskrivelse

Benævnelse

Transformatormodul til placering i vindmølle

Frembringelsens anvendelsesområde

Denne frembringelse vedrører et transformatormodul, der kan opstilles i et tårn til en vindmølle eller lignende.

Der er tale om et selvstændigt modul, der kan opstilles direkte på vindmøllens fundament eller højere i mølletårnet. Hvis opstilling sker direkte på fundamentet, opstilles modulet før mølletårnet, der herefter kan sænkes ned over transformatormodulet.

Transformatormodulet kan anvendes i forbindelse med vindmøller, der opstilles såvel på land som til vands. Den er særligt anvendelig til vindmøller, der opstilles på vanskeligt tilgængelige steder og på havet. Modulet forenkler, rationaliserer og billiggør den elektriske installation for vindmøller, bl.a. muliggør modulet, at al kranarbejde kan udføres i én arbejdsgang.

Transformatormodulet kan indeholde en højspændingstransformer og nødvendige højspændingsinstallationer til vindmøllen. Transformatormodulets top er udført som en bærende platform, og eventuelle elektriske styringstavler og andet udstyr til vindmøllen kan derfor placeres her.

Transformatormodulet opbygges således, at det har tilstrækkelig styrke og bæreevne til, at den kan flyttes og løftes i fuldt monteret tilstand (inkl. transformator). Det mest velegnede materiale er formentlig stål.

Enhedens ydre størrelse tilpasses diameteren på vindmøllens tårn.

Kendt teknik

Med den kendte teknik opstilles højspændingstransformere til vindmøller i selvstændige transformatorhuse uden for vindmøllerne. Dette medfører, at der skal etableres selvstændige fundamenter til disse, at kabelforbindelsen mellem møllen og transformatorstationen skal sikres med sikringer og at transformeren skal stå i et vejrbestandig transformatorhus. Der benyttes sædvanligvis standardiserede transformatorhuse.

I enkelte tilfælde har man direkte på en vindmøllens tårn påsvejet beslag til indvendig montering af transformator. Dette indebærer en vanskelig, farlig og bekostelig montage af

transformatorerne, idet disse enten skal nedsænkes eller løftes i det monterede mølletårn, samt brug af mange løsdele. Den kendte teknik medfører desuden, at en eventuel udskiftning af transformatoren er særdeles vanskelig. Påsvejsning medfører endvidere at metallet slår sig, hvilket kan medføre at tårnet bliver ovalt, og dermed er sammenboltning af tårnehederne vanskelig eller ikke mulig.

Med de kendte teknikker er det ikke muligt at montere den nødvendige transformator og de nødvendige højspændingsinstallationer inde i vindmøllen i en standardiseret enhed, idet de kendte transformatorhuse ikke har været beregnet til dette formål. Dette skyldes, at de trange pladsforhold ikke tillader anvendelse af traditionelle firkantede transformatorhuse.

I modsætning til den kendte teknik muliggør frembringelsen således montering af transformer og eventuelle højspændingsinstallationer i vindmøllens tårn i en enhed.

Det tekniske problem der skal løses.

For at reducere transmissionstab i opsamlingsnettet, skal strømmen produceret af vindmøller, transformeres til højspænding så tæt på vindmøllens generator som muligt. Frembringelsen gør det muligt at montere transformatoren i vindmøllens tårn tæt på generatoren. De kendte standardiserede transformatorhuse er beregnet til montage på jorden og kan ikke fysisk placeres i et tårn til en vindmølle.

Den kraftige opbygning af modulet og platformen på transformatormodulets top forøger mulighederne for placering af de elektriske styringstavler og andet udstyr til vindmøllen, idet disse kan placeres og monteres på den nævnte platform, hvor vindmøllens dør ikke begrænser opstillingsmulighederne.

Transformatormodulet er udformet således, at det er muligt at foretage sædvanlig servicering og eftersyn på møllen. Dette medfører at vindmøllens komponenter, herunder bolte, er tilgængelige. Endvidere er transformatormodulet udformet således, at det ikke hindrer adgangen til stigen monteret på mølletårnet. Det er således forsat muligt at få adgang til vindmøllens top.

Frembringelsen løser de praktiske vanskeligheder ved montering af en transformer inde i en vindmøllens tårn, idet tunge løft inde i tårnet undgås samt at kranarbejde kan ske i en arbejdsgang.

Den nye teknik

Det nye ved frembringelsen er, at transformatorstationen er udformet som et selvstændigt modul tilpasset vindmølletårnets form, således at transformatoren kan placeres inde i vindmøllen.

For det andet er det en nyskabelse, at transformatorstationen opbygges af sådanne materialer, at transformatorstationen kan håndteres og løftes med transformatoren og øvrigt nødvendigt udstyr monteret. Det p.t. mest velegnede materiale er stål.

For det tredje er det en nyskabelse, at der monteres en stabil og kraftig platform over transformatorhuset, hvor der kan ske montage og opstilling af styreskabe og øvrigt udstyr. Dette muliggør styreskabenes montage direkte på transformatorens lavspændingsdel, uden brug af kabler og sikringer, hvilket billiggør installationen. Endvidere skaber platformen yderligere plads til opstilling af udstyr.

For det fjerde er det en nyskabelse, at en transformatorstation placeres på ben for at muliggøre montage og eftersyn af tårnsektionernes bolte, og møllens øvrige elektriske installationer, under transformatormodulet.

Den tekniske virkning.

Den tekniske virkning er, at man i modulform kan montere det nødvendige højspændingsudstyr, herunder en transformator, i en vindmøllens tårn.

Den nye monteringsmetode medfører, at højspændingsinstallationen til vindmøller forenkles og rationaliseres, idet der ikke skal bygges et vejrbestandigt hus til transformatoren, at der ikke skal etableres et selvstændigt fundament til et sådant hus og at transformatoren er sikret mod hærværk. Muligheden for at opstille styreskabe på platformen over transformatorhuset medfører, at der ikke er behov for kabler og sikringer mellem transformatorens lavspændingsside og vindmøllens styreskabe og at der skabes yderligere plads til montage af vindmøllens elektriske styringstavler, idet vindmøllen ikke har en dør i denne højde.

Frembringelsen er specielt relevant på steder hvor der vanskeligt kan opstilles en selvstændig transformatorstation. Dette gælder eksempelvis på havet, idet man med et færdigmonteret transformatormodul kan reducere den nødvendige krantid. Kranarbejdet nødvendiggør de i brugsmodelkrav 4 anførte løftebeslag. Med modulet er det muligt at anvende samme teknik på havet, som anvendes på land. Dermed er der ikke brug for forskellige modeller af vindmøllerne, til de forskellige opstillingssteder.

Ved opstilling af transformatormodulet direkte på det støbte møllefundament, skal transformatormodulet forsynes med de i brugsmodelkrav 5 nævnte ben. Dermed sikres, at der kan ske montage og eftersyn under transformatormodulet. Dermed vil det fortsat bl.a. være muligt at foretage efterspænding af tårnsektionernes bolte.

Frembringelsen indebærer såvel en teknisk rationalisering i forbindelse med opstilling af en transformator til en vindmølle, som en økonomisk besparelse.

Figurfortegnelse.

Figur 1 er et foto af et eksempel på en model på et transformatormodul til montage direkte på vindmøllens fundament.

Figur 2 er et foto af modellen der viser placeringen på vindmøllens fundament. Ringen omkring transformatormodulet er vindmøllens nedstøbningssektion i stål. Fotoet viser desuden den nederste tårnsektion, der nedsænkes over modulet.

Figur 3 er en skitse der viser en traditionel opbygning af en højspændingsinstallation til en vindmølle

Figur 4 er en skitse af en vindmølle, hvor man benytter det nye transformatormodul, opstillet på vindmøllens fundament

Figur 5 er en skitse af en vindmølle, hvor man benytter det nye transformatormodul monteret oppe i vindmøllens tårn. Det bemærkes, at man undgår placering ved tårnmodulernes samlinger af hensyn til efterspænding af bolte.

Udførelseseksempler.

Ovennævnte figur 1 viser et eksempel på udformningen af det beskrevne transformatormodul. Det viste eksempel er beregnet til opstilling direkte på vindmøllens fundament, og er derfor forsynet med ben. Benene skal have en længde der gør det muligt at foretage montagearbejde under modulet. Transformatormodulet kan opbygges af flere forskellige materialer. Det p.t. mest velegnede er formentlig stål.

Det viste eksempel på transformatormodulet kan indeholde en transformator, og i modulet vil der være mulighed for montage af øvrige højspændingsinstallationer. Styreskabe og lignende kan opstilles på platformen, der udgør modulets top. Det viste eksempel er udformet således, at der kan foretages montage og eftersyn af vindmøllen, selvom transformatormodulet er opstillet i mølletårnet.

Udskæringen i modulets øverste platform giver plads til stigen, der er monteret på mølletårnet. Transformatormodulet er udformet således, at der fortsat er uhindret adgang til vindmøllens nacelle.

Brugsmodelkrav.

1. Transformatormodul til placering i vindmøller, hvori der kan stå en transformator, og som er ny ved, at den er udformet således, at den som en selvstændig enhed kan monteres inde i vindmøllers tårne.
2. Transformatormodul til placering i vindmøller, hvori der kan stå en transformator, og som er ny ved, at den er tilpasset formen på et vindmølleårn.
3. Transformatormodul til placering i vindmøller ifølge krav 1 eller 2, som er ny ved, at der er monteret en stabil og bæredygtig platform over transformatorhuset, hvilket medfører, at der kan ske montage af transformator, uden at der skal monteres kabler og sikringer, samt at der skabes plads til montage af styretavler og lignende.
4. Transformatormodul til placering i vindmøller ifølge et hvilket som helst af de foregående krav, som er ny ved, at den er forsynet med løftebeslag af eksempelvis stål, der er fastgjort til modulets bærende konstruktion, og som har en styrke og bæreevne, der tillader at flytte og løfte modulet i færdigmonteret tilstand (inkl. transformator og eventuelle styretavler på modulets top).
5. Transformatormodul til placering i vindmøller ifølge et hvilket som helst af de foregående krav, som er ny ved, at den er forsynet med ben, således at der etableres mulighed for montage og eftersyn under modulet.
6. Transformatormodul til placering i vindmøller ifølge et hvilket som helst af de foregående krav, som er ny ved, at den er forsynet med ben og luge, således at der etableres mulighed for montage og eftersyn under modulet.

Figur 1

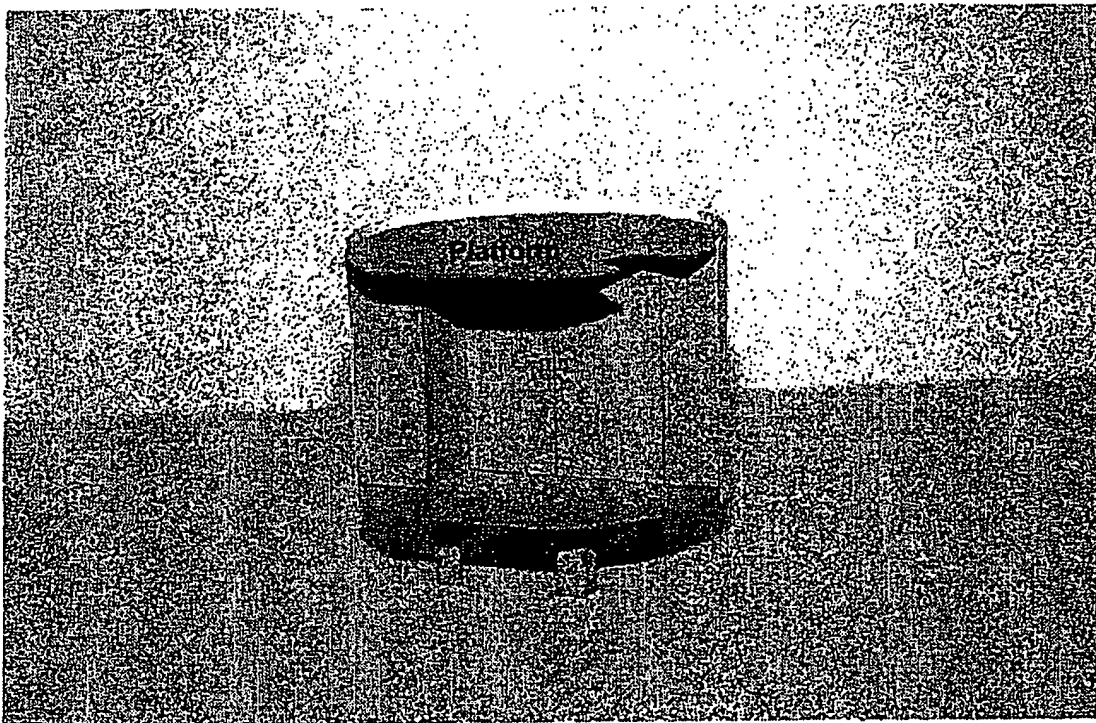
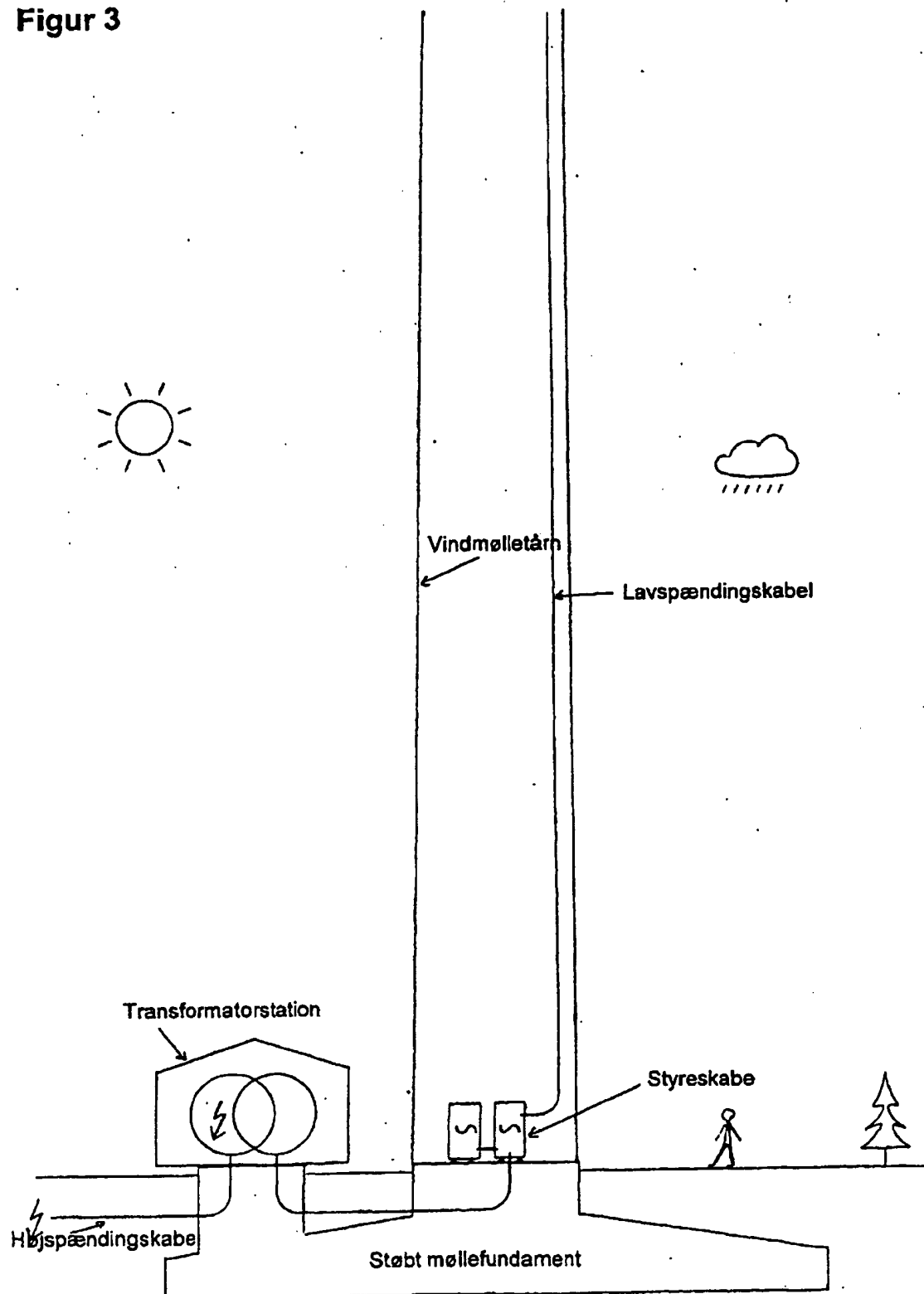


Foto af et eksempel på en model af et transformator modul til montage direkte på vindmøllens støbte fundament.

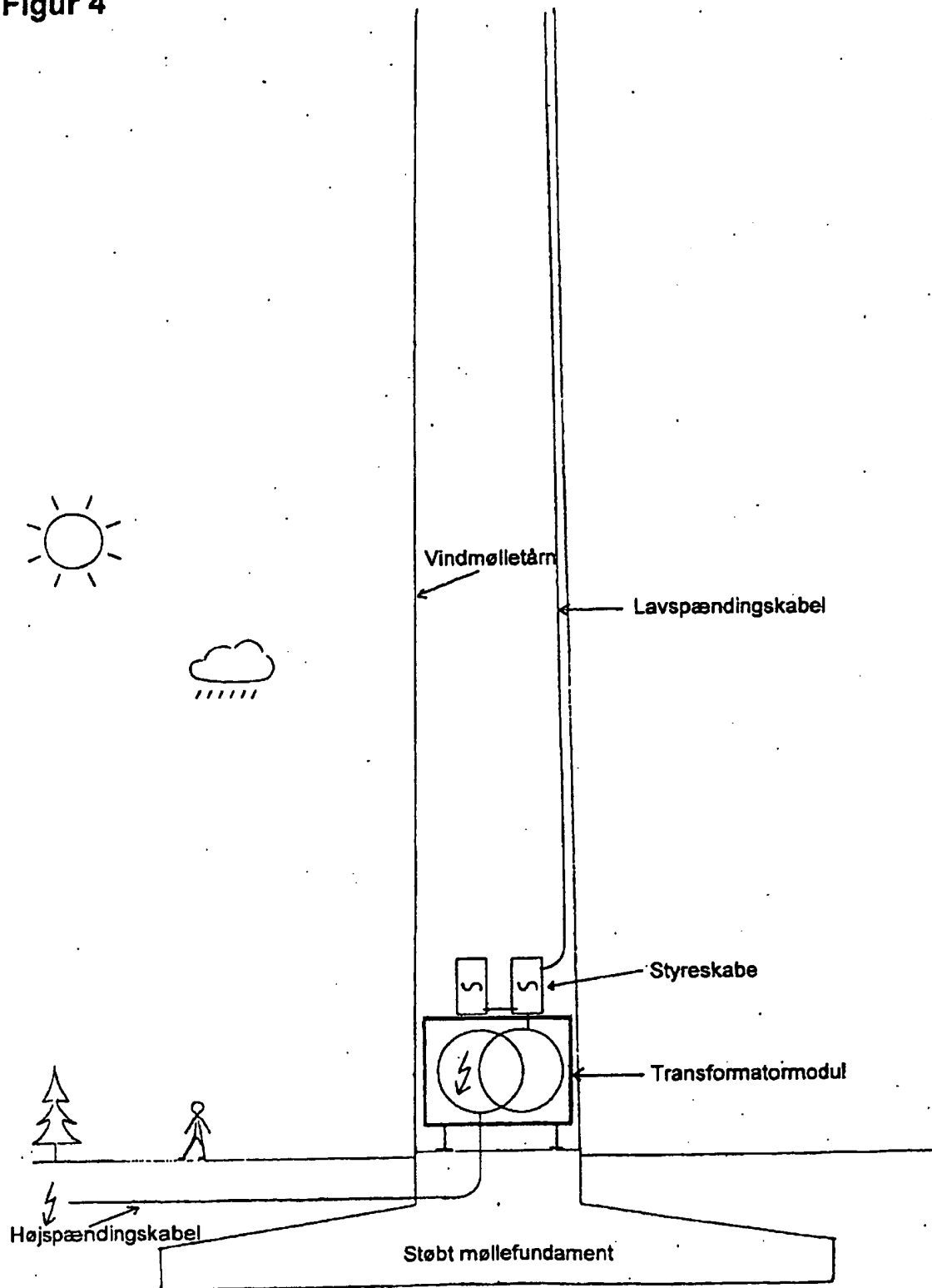
Figur 2



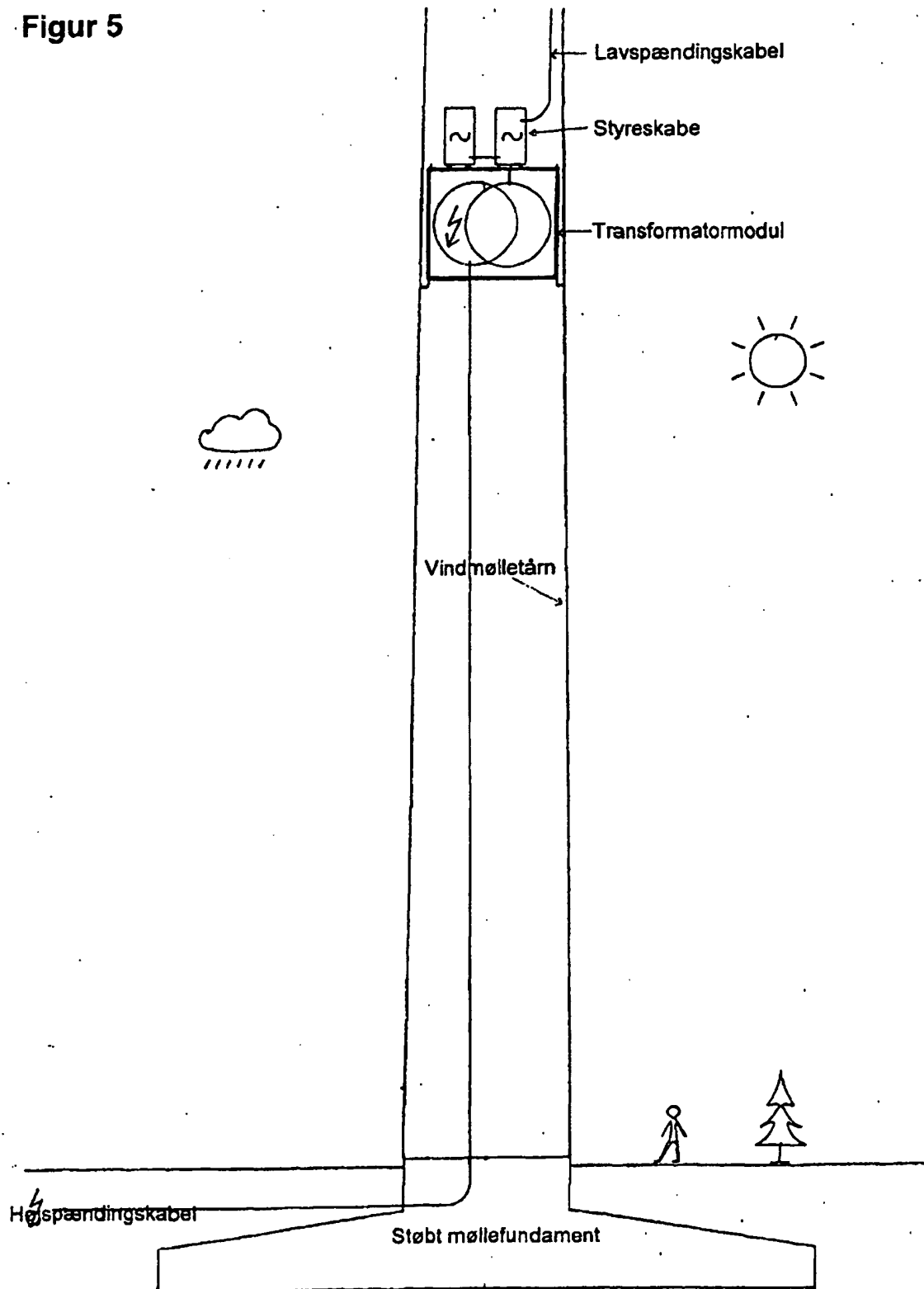
Figur 3



Figur 4



Figur 5



English translation of E1a

Transformer module for positioning in a wind turbine

5 The invention's scope of application

The present invention relates to a transformer module which can be positioned in a tower of a wind turbine or the like.

10 The module is an independent unit which may be positioned directly on the foundation of the wind turbine or higher up in the wind turbine tower. If the positioning takes place directly on the foundation, the module is positioned before the wind turbine tower, which is subsequently lowered down over the transformer module.

15 The transformer module can be used in connection with wind turbines which are erected onshore as well as offshore. It is especially applicable in connection with wind turbines to be erected offshore and at sites where access is difficult. The module simplifies, rationalises and optimises the costs of the electrical installation of the wind turbines, among other things because the module enables all crane work to be carried out in one operation.

20 The transformer module can include a high voltage transformer and necessary high voltage installations for the wind turbine. The top of the transformer module is configured as a load-bearing platform, and any electrical control panels and other equipment for the wind turbine can therefore be placed on this platform.

25 The transformer module is constructed in such a manner that it has sufficient strength and load-bearing capacity to enable it to be moved and lifted in a fully mounted state (including the transformer). The most suitable material is presumably steel.

30 The outer dimensions of the module are adapted to the diameter of the wind turbine tower.

The known technique

turbine and the transformer station shall be protected with fuses, and that the transformer shall stand in a weatherproof transformer housing. Usually, standardised transformer housings are used.

- 5 In some cases, brackets for the internal mounting of transformers are welded directly on the tower of the wind turbine. This involves a difficult, dangerous and costly mounting of the transformers, the reason being that these shall either be lowered or raised in the mounted turbine tower, and involves the use of many loose parts. Moreover, use of the known technique means that a possible replacement of the transformer is particularly difficult. The
10 welding work can also give rise to a buckling of the metal, which can result in the tower becoming oval, and the bolting-together of the tower units is herewith difficult or rendered impossible.

- With the known techniques, it is not possible to mount the necessary transformer and the
15 necessary high voltage installations inside the wind turbine as a standardised unit, the reason being that the known transformer housings have not been intended for this purpose. This is due to the restricted space conditions, which do not permit the use of traditional, quadratic transformer housings.

- 20 Unlike the known technique, the invention thus enables the mounting of transformers and possible high voltage installations in the tower of the wind turbines as one unit.

The technical problem which needs to be solved.

- 25 In order to reduce the transmission loss in the collection network, the current produced by wind turbines must be transformed to high voltage as close as possible to the wind turbine generator. The invention makes it possible to mount the transformer in the tower of the wind turbine close to the generator. The known standardised transformer housings are designed for erection on the ground and can not physically be placed in a tower of a wind turbine.

- 30 The strong construction of the module and the platform on the top of the transformer module increases the possibilities for positioning of the electrical control panels and other equipment for the wind turbine, inasmuch as these can be placed and mounted on the said platform, where the door of the wind turbine does not restrict the possibilities of erection.

The transformer module is configured in such a manner that it is possible to carry out normal servicing and inspection on the turbine. The result is that the wind turbine's components, including bolts, are accessible. Moreover, the transformer module is configured in such a manner that it does not hinder the access to the ladder mounted on the turbine tower. It is thus still possible to gain access to the top of the wind turbine.

The invention solves the practical difficulties involved in the mounting of a transformer inside the tower of a wind turbine, the reason being that heavy lifting inside the tower is avoided and that crane work can be carried out in one operation.

The new technique

The innovative aspect of the invention is that the transformer station is configured as an independent module adapted to the shape of the wind turbine tower, so that the transformer can be placed inside the wind turbine.

Secondly, it is innovative that the transformer station is constructed in such materials that the transformer station can be handled and lifted with the transformer and any other necessary equipment mounted. At present, the most suitable material is steel.

Thirdly, it is innovative that a strong and stable platform is mounted on top of the transformer housing, where the mounting and positioning of control panels and other equipment can take place. This enables the control panels to be mounted directly on the transformer's low voltage section without the use of cables and fuses, which reduces the costs of the installation. The platform also establishes further space for the positioning of equipment.

Fourthly, it is innovative that a transformer station is placed on legs in order to enable assembly and inspection under the transformer module of the tower sections' bolts and other electrical installations.

The technical effect

The technical effect is that the necessary high voltage equipment, including a transformer, can be mounted in modular form in the tower of a wind turbine.

5

The result of the new method of mounting is that the high voltage installation for wind turbines is simplified and rationalised, inasmuch as the building of a weatherproof housing for the transformer is not necessary, and an independent foundation for such a housing does not need to be established and that the transformer is secured against vandalism. The possibility
10 of being able to mount control panels on the platform on top of the transformer housing means that there is no need for cables and fuses between the low voltage side of the transformer and the wind turbine's control cabinet and, since the wind turbine does not have a door at this height, that additional space is created for the mounting of the wind turbine's control panels.

15

The invention is particularly relevant at places where it is difficult to erect an independent transformer station. For example, this applies offshore where with a ready-mounted transformer module the necessary crane time can be reduced. The crane work necessitates the lifting brackets described in the utility model claim 4. With the module, it is possible to use
20 the same technique offshore as that used on land. There is thus no use for wind turbines of different models for the different places of erection.

With the erection of the transformer module directly on a moulded turbine foundation, the turbine module must be provided with the legs disclosed in utility model claim 5. It is
25 herewith ensured that mounting and inspection can be implemented under the transformer module. It will hereby thus continue to be possible, among other things, to carry out a subsequent tightening of the tower sections' bolts.

As well as a technical rationalisation in connection with the erection of a transformer for a
30 wind turbine, the invention also offers financial savings.

The figures

Figure 1 is a photograph of an example of a model of a transformer module for mounting directly on the foundation of a wind turbine.

5 Figure 2 is a photograph of a model which shows the positioning on the wind turbine foundation. The ring around the transformer module is the wind turbine's imbedded section in steel. The photo also shows the lowermost tower section, which is lowered down over the module.

10 Figure 3 is a sketch which shows a traditional construction of a high voltage installation for a wind turbine.

Figure 4 is a sketch of a wind turbine, where use is made of the new transformer module mounted on the foundation of the wind turbine.

15 Figure 5 is a sketch of a wind turbine, where use is made of the new transformer module mounted up in the tower of the wind turbine. It will be noted that positioning at the joints of the tower modules is avoided out of regard for a subsequent tightening of bolts.

Example embodiments

20 The above-mentioned figure 1 shows an example of an embodiment of the disclosed transformer module. The shown example is intended for mounting directly on the foundation of the wind turbine, and is therefore provided with legs. The legs shall be of a length which makes it possible to carry out assembly work under the module. The transformer module can be built up of several different materials. At present, the most suitable material is presumably steel.

25 The shown example of the transformer module can contain a transformer, and the mounting of other high voltage installations will be possible inside the module. Control cabinets and the like can be erected on the platform which constitutes the top of the module. The example shown is configured so that the assembly and inspection of the wind turbine can be carried out even though the transformer module is mounted in the tower of the turbine.

30 The cut-out in the module's uppermost platform provides room for the ladder which is mounted on the tower of the wind turbine. The transformer module is configured in such a manner that unhindered access to the nacelle of the wind turbine continues to be possible.

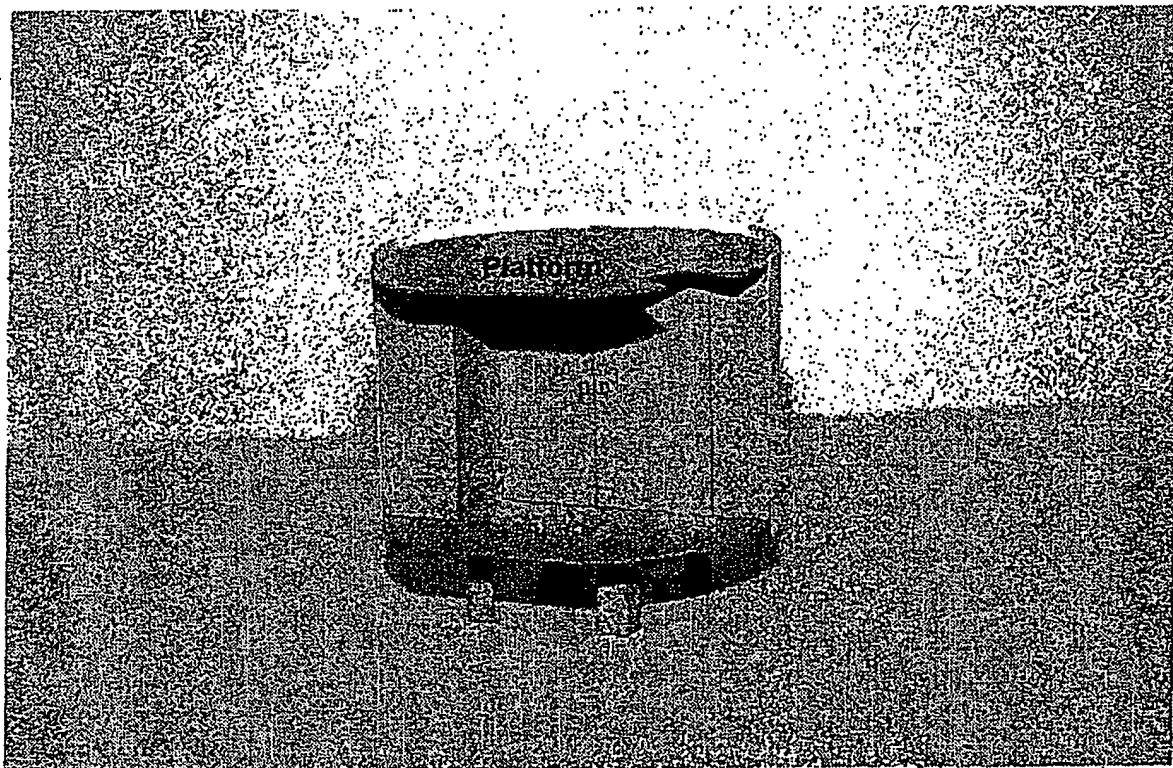
Utility model claims

1. Transformer module for positioning in wind turbines, in which module a transformer can be placed and which is innovative by being configured in such a manner that it can be mounted inside a wind turbine tower as an independent unit.
2. Transformer module for positioning in wind turbines, in which module a transformer can be placed and which is innovative by being adapted to the shape of a wind turbine tower.
3. Transformer module for positioning in wind turbines according to claim 1 or 2, and which is innovative by a stable and load-bearing platform being mounted on top of the transformer housing, with the result that transformers can be mounted without the need for the mounting of cables and fuses, and that space is created for the mounting of control panels and the like.
4. Transformer module for positioning in wind turbines according to any of the foregoing claims, and which is innovative by being provided with lifting brackets of, e.g. steel, which are secured to the module's supporting construction and which have a strength and load-bearing capacity which permits the module to be lifted and moved in the ready-mounted state (including transformer and possible control panels on top of the module).
5. Transformer module for positioning in wind turbines according to any of the foregoing claims, and which is innovative by being provided with legs so that the possibility is established for assembly and inspection under the module.
6. Transformer module for positioning in wind turbines according to any of the foregoing claims, and which is innovative by being provided with legs and a hatch so that the possibility is established for assembly and inspection under the module.

Abstract

The invention relates to a transformer module for positioning in wind turbines, which makes it possible to mount a transformer and other high voltage installations inside the tower of a wind turbine in a rational and inexpensive manner. The invention is innovative by the transformer station being adapted to the shape of the wind turbine and that it constitutes an independent and complete unit, and that it is provided with strong lifting brackets and provided uppermost with a stable and strong platform, and that in cases where it is erected directly on the moulded foundation of the wind turbine, it is provided with legs which enable mounting work to be carried out under the module. The module can be mounted either directly on the wind turbine foundation or mounted up in the tower of the wind turbine. The transformer module is provided uppermost with a platform on which control cabinets for the wind turbine can be mounted, and it is configured in such a manner that assembly and service of the wind turbine and the transformer module is possible. The transformer module renders the erection of external transformer stations superfluous. The module is suitable in the erection of wind turbines in all places, among other things where erection takes place offshore.

Figure 1



Photograph of an example of a model of a transformer module for mounting directly on the moulded foundation of a wind turbine.

Figure 2

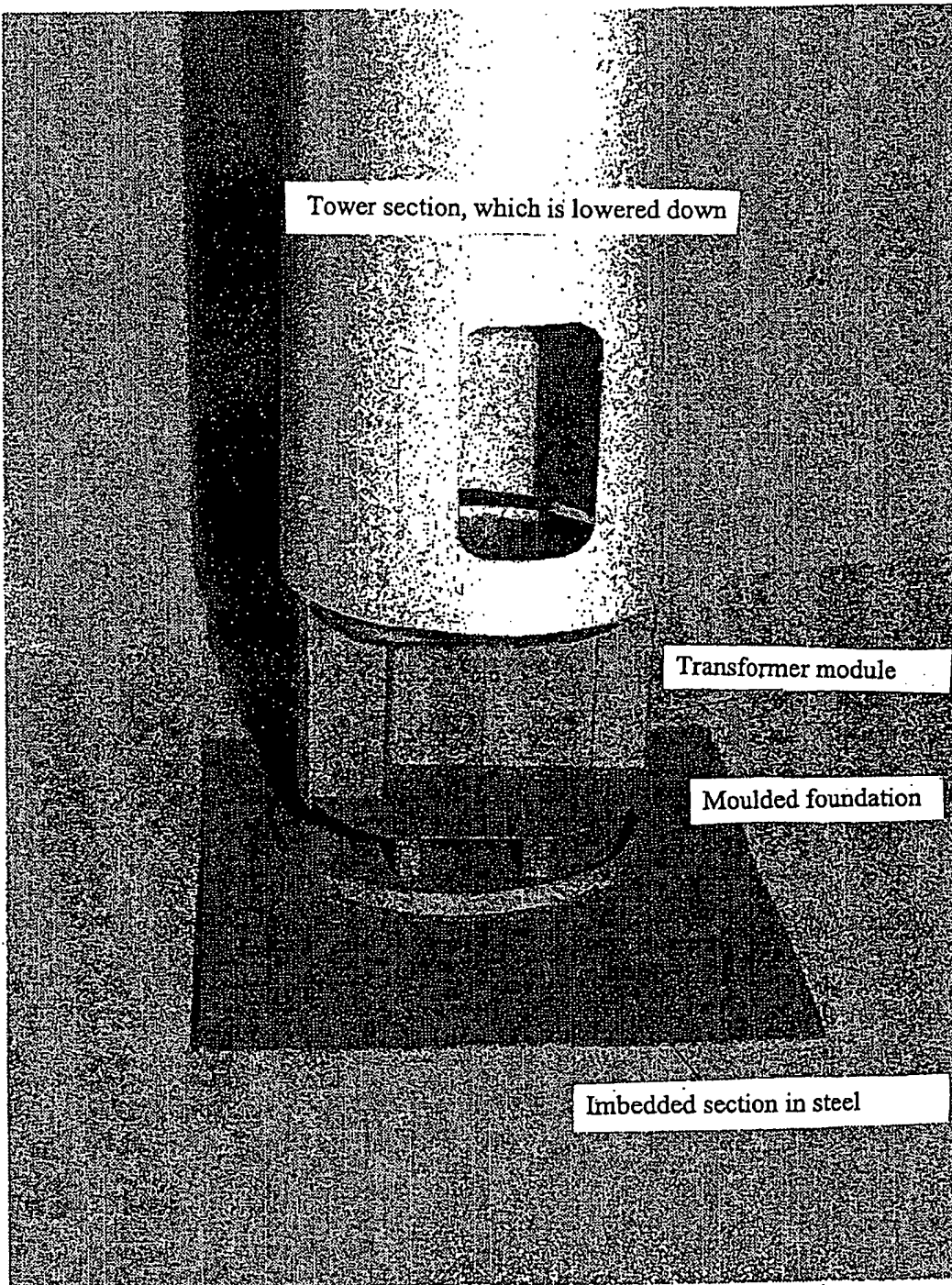


Figure 3

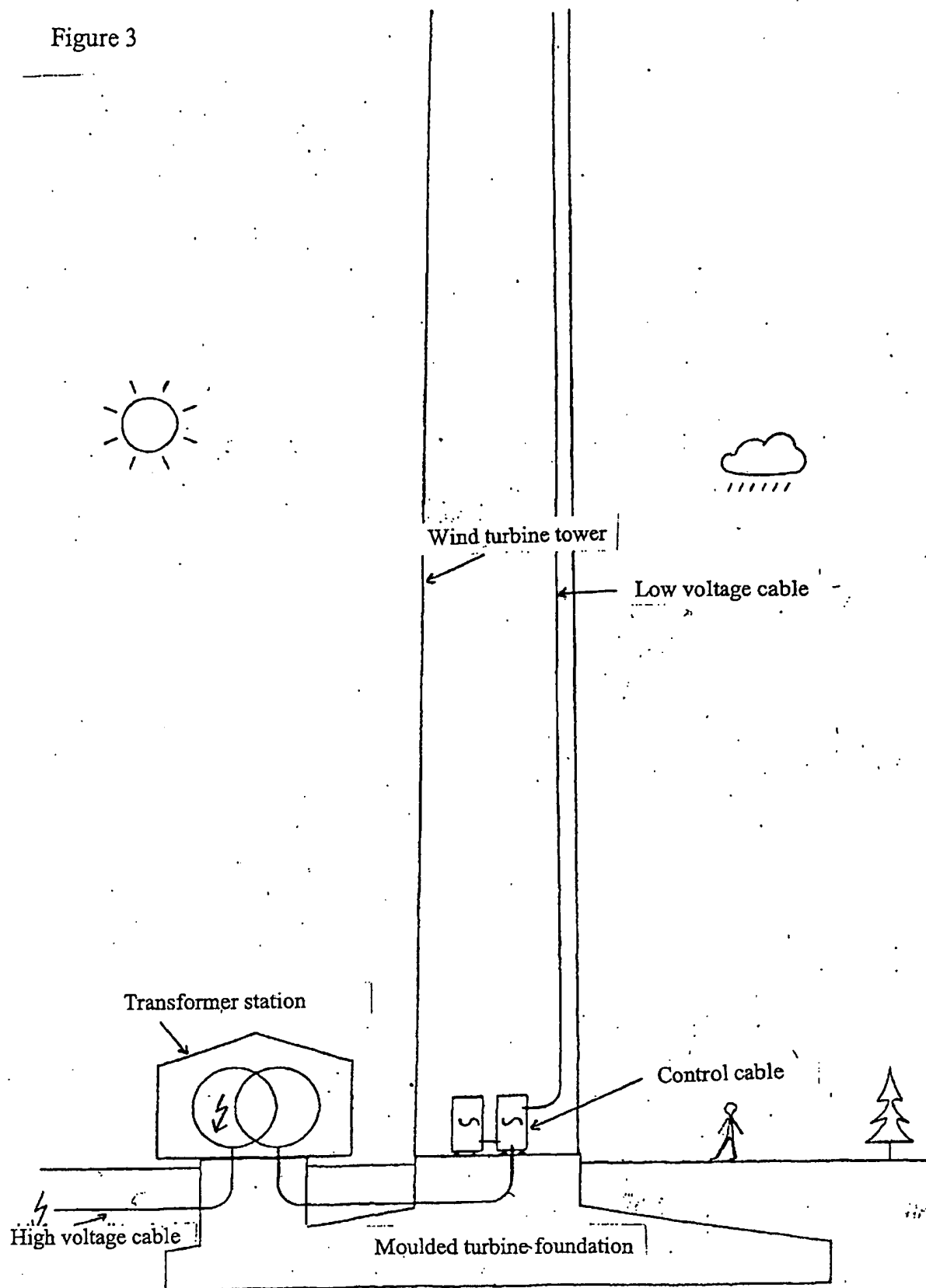


Figure 4

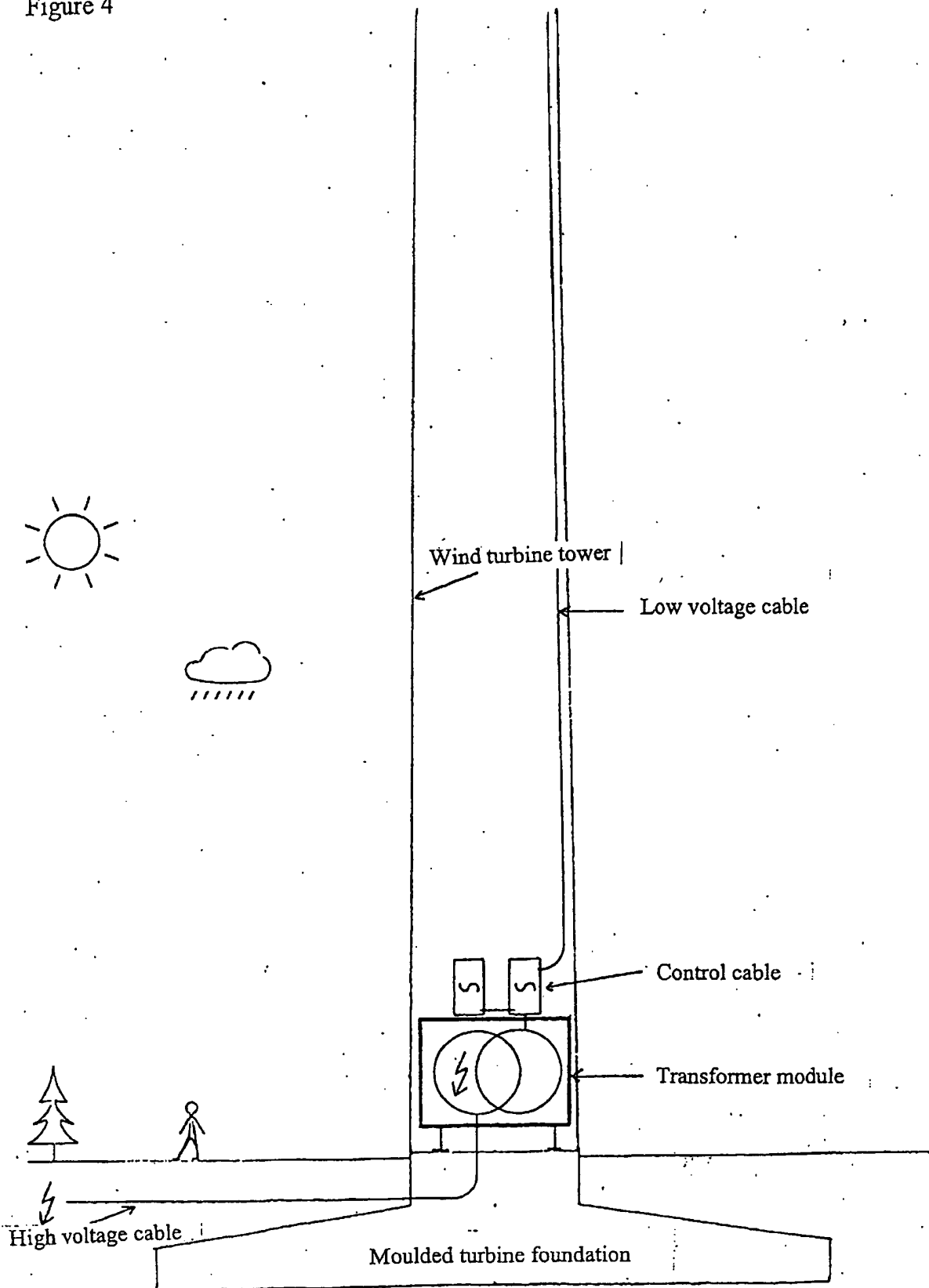
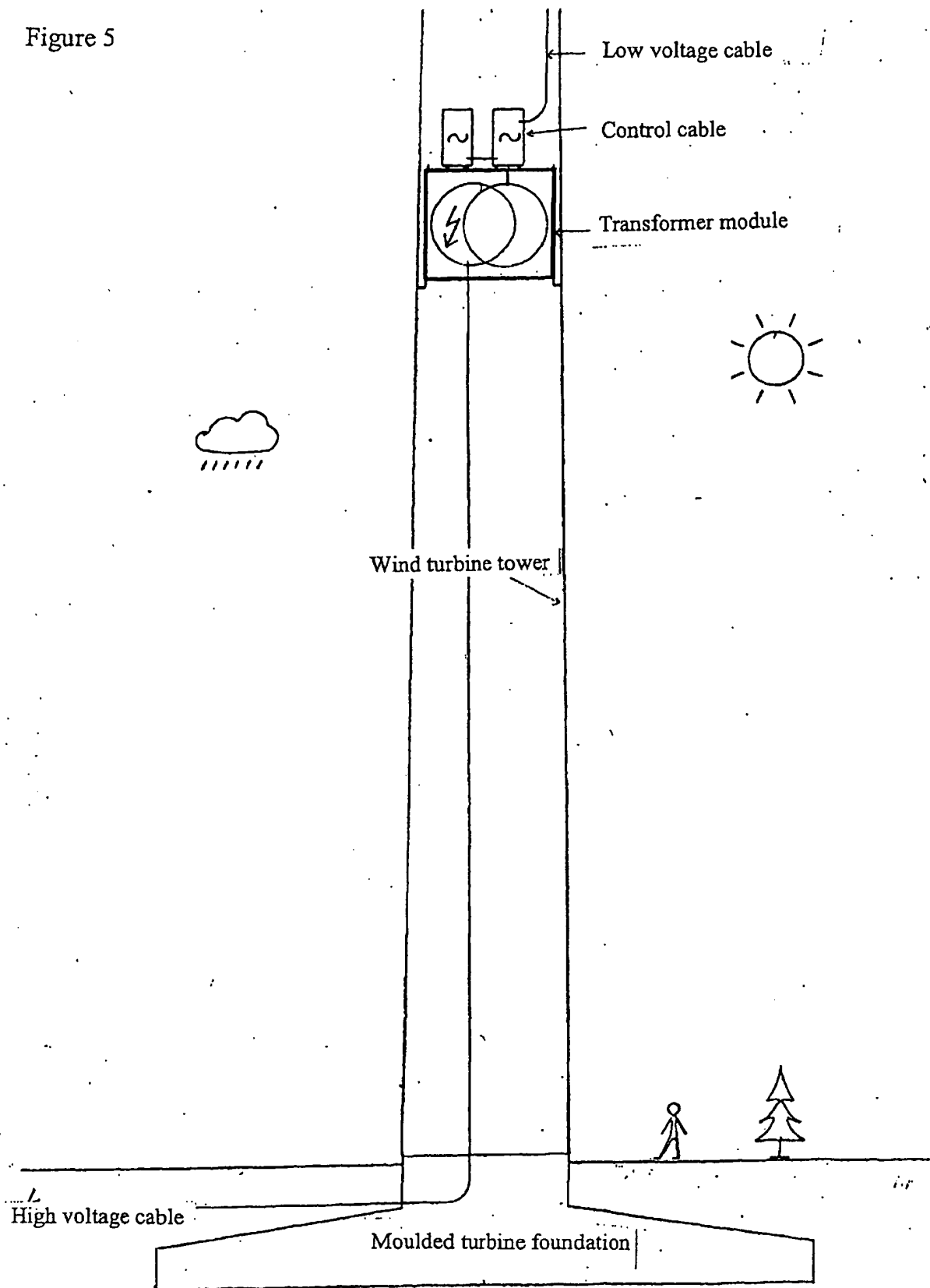


Figure 5



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